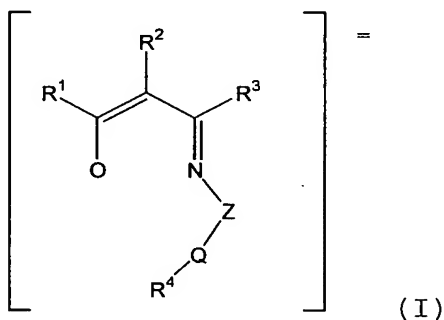


CLAIMS

What is claimed is:

1. A process for the polymerization of olefins, comprising the step of contacting, at a temperature of about -100°C to about $+200^{\circ}\text{C}$, one or more monomers selected from the group consisting of ethylene and an olefin of the formula $\text{H}_2\text{C}=\text{CH}(\text{CH}_2)_n\text{H}$ (XXII), and a Cr, Mn, V, Ti, Zr or Hf complex of an anion of the formula (I)

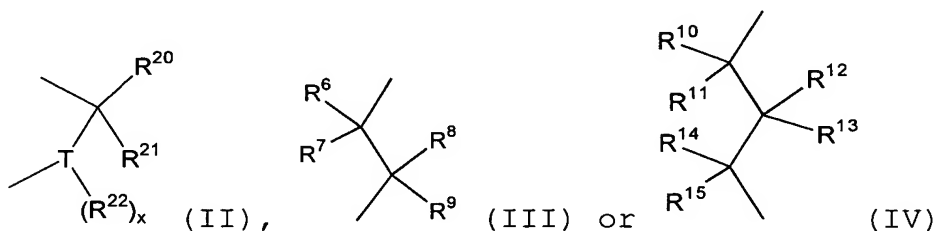
10



wherein:

- R^1 is hydrocarbyl or substituted hydrocarbyl, R^2 is hydrogen, hydrocarbyl or substituted hydrocarbyl, and R^3 is hydrogen, hydrocarbyl, substituted hydrocarbyl or a functional group, provided that R^1 and R^2 taken together may be ortho-arylene or substituted ortho-arylene, or R^1 , R^2 and R^3 taken together may form one or more rings;

Z is a bridging group of the formula (II), (III) or (IV)



25

Q is nitrogen, oxygen, phosphorous or sulfur, provided that when Z is (II), Q is oxygen;

R⁴ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that when Q is oxygen or sulfur R⁴ is not present;

5 R⁶ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R³ and R⁶ together may form a ring;

10 R⁷ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R³, R⁶ and R⁷ together may form an aromatic ring, or R⁶ and R⁷ taken together may form a ring;

R⁸ is hydrogen, hydrocarbyl or substituted hydrocarbyl;

15 R⁹ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R⁴ and R⁹ taken together may be part of a double bond to an imino nitrogen atom, or R⁸ and R⁹ taken together may form a carbonyl with the carbon to which they are attached, or R⁸ and R⁹ taken together may form a ring, or R⁴ and R⁹ taken together may form a ring, or R⁴, R⁸ and R⁹ taken together may
20 form a ring, or R⁶, R⁷, R⁸ and R⁹ taken together may form an aromatic ring;

25 R¹⁰, R¹¹, R¹² and R¹³ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R¹⁰, R¹¹, R¹² and R¹³ taken together may be ortho-arylene;

30 R¹⁴ and R¹⁵ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R¹⁴ and R¹⁵ taken together may form a carbonyl with the carbon to which they are attached, or R¹², R¹³, R¹⁴, and R¹⁵ taken together may form an o-arylene group, or R¹⁰, R¹¹, R¹², R¹³, R¹⁴, and R¹⁵ taken together may form a fused aromatic ring system, or R¹³ and R¹⁴ taken together may form a ring;

35 R²⁰ and R²¹ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, or R²⁰ and R²¹ taken together may form a ring;

each R²² is individually hydrocarbyl, oxygen or alkoxy, provided that when R²² is oxygen, two of R²² are taken together to form T=O;

n is an integer of 1 or more;

5 T is phosphorous or sulfur whose oxidation state is 3 or greater; and

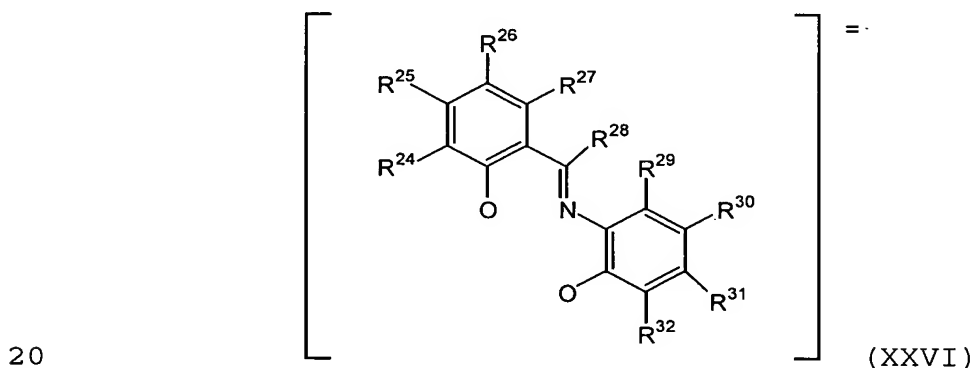
x is equal to the oxidation state of T minus 2.

2. The process as recited in claim 1, wherein the monomer is ethylene.

10 3. The process as recited in claim 1, wherein the transition metal is selected from the group consisting of Zr and Ti.

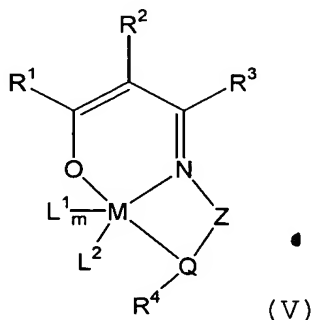
4. The process as recited in claim 1, wherein R¹ and R² taken together are o-arylene, Z is a group of
15 the formula (III), Q is oxygen, and R⁶, R⁷, R⁸ and R⁹ taken together form an aromatic ring.

5. The process as recited in claim 4, wherein (I) has the formula



wherein R²⁴, R²⁵, R²⁶, R²⁷, R²⁹, R³⁰, R³¹ and R³² are each independently hydrogen, hydrocarbyl, substituted hydrocarbyl or a functional group, and R²⁸ is hydrogen,
25 hydrocarbyl, or substituted hydrocarbyl, provided that any two of R²⁴, R²⁵, R²⁶, R²⁷, R²⁹, R³⁰, R³¹ and R³² vicinal to one another may be taken together to form a ring, and that R²⁷ and R²⁸ may be taken together to form a ring, or R²⁸ and R²⁹ may be taken together to
30 form a ring.

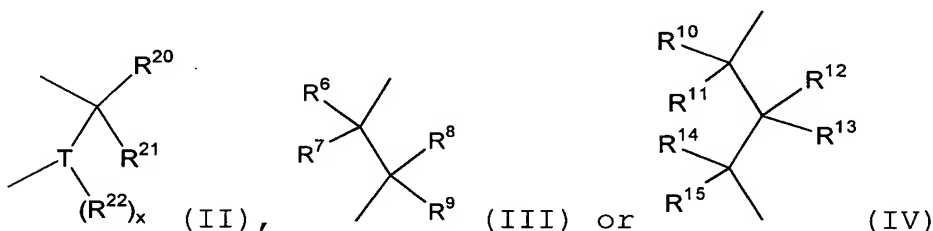
6. A process for the polymerization of olefins, comprising the step of contacting, at a temperature of about -100°C to about $+200^{\circ}\text{C}$, one or more monomers selected from the group consisting of ethylene and
 5 $\text{H}_2\text{C}=\text{CH}(\text{CH}_2)_n\text{H}$ (XXII), with a compound of the formula (V)



10 wherein:

R^1 is hydrocarbyl or substituted hydrocarbyl, R^2 is hydrogen, hydrocarbyl or substituted hydrocarbyl, and R^3 is hydrogen, hydrocarbyl, substituted hydrocarbyl or a functional group, provided that R^1 and
 15 R^2 taken together may be ortho-arylene or substituted ortho-arylene, or R^1 , R^2 and R^3 taken together may form one or more rings;

Z is a bridging group of the formula (II), (III) or (IV)
 20



Q is nitrogen, oxygen, phosphorous or sulfur, provided that when Z is (II), Q is oxygen;
 25 R^4 is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that when Q is oxygen or sulfur R^4 is not present;

R⁶ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R³ and R⁶ taken together may form a ring;

5 R⁷ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R³, R⁶ and R⁷ taken together may form an aromatic ring, or R⁶ and R⁷ taken together may form a ring;

R⁸ is hydrogen, hydrocarbyl or substituted hydrocarbyl;

10 R⁹ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R⁴ and R⁹ taken together may be part of a double bond to an imino nitrogen atom, or R⁸ and R⁹ taken together may form a carbonyl with the carbon to which they are attached, or R⁸ and R⁹ taken
15 together may form a ring, or R⁴ and R⁹ taken together may form a ring, or R⁴, R⁸ and R⁹ taken together may form a ring, or R⁶, R⁷, R⁸ and R⁹ taken together may form an aromatic ring;

20 R¹⁰, R¹¹, R¹² and R¹³ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R¹⁰, R¹¹, R¹² and R¹³ taken together may be ortho-arylene;

R¹⁴ and R¹⁵ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that
25 R¹⁴ and R¹⁵ taken together may form a carbonyl with the carbon to which they are attached, or R¹², R¹³, R¹⁴, and R¹⁵ taken together may form an o-arylene group, or R¹⁰, R¹¹, R¹², R¹³, R¹⁴, and R¹⁵ taken together may form a fused aromatic ring system, or R¹³ and R¹⁴ taken
30 together may form a ring;

R²⁰ and R²¹ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, or R²⁰ and R²¹ taken together may form a ring;

35 each R²² is individually hydrocarbyl, oxygen or alkoxy, provided that when R²² is oxygen, two of R²² are taken together to form T=O;

n is an integer of 1 or more;

T is phosphorous or sulfur whose oxidation state is 3 or greater;

x is equal to the oxidation state of T minus 2;

M is Ti, Zr, Hf, V, Mn or Cr;

5 m is an integer equal to the valence of M minus 2; and

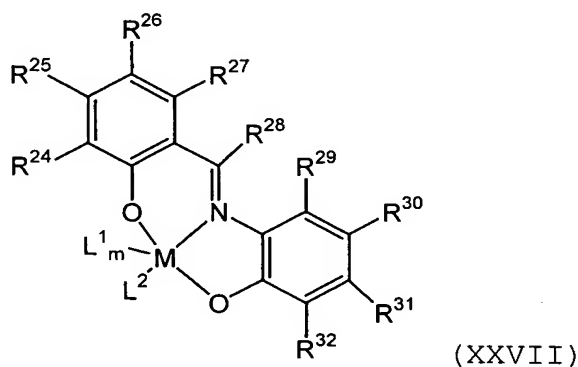
each L^1 is independently a monodentate monoanionic ligand and at least for one of L^1 an ethylene molecule may insert between L^1 and M, and L^2 is a monodentate neutral ligand which may be displaced by ethylene or an empty coordination site, provided that an L^1 and L^2 taken together may be a monoanionic polydentate ligand and at least for one of these monoanionic polydentate ligands ethylene may insert
15 between said monoanionic polydentate ligand and M.

7. The process as recited in claim 6, wherein the monomer is ethylene.

8. The process as recited in claim 6, wherein the transition metal is selected from the group consisting
20 of Zr and Ti.

9. The process as recited in claim 6, wherein R^1 and R^2 taken together are o-arylene, Z is a group of the formula (III), Q is oxygen, and R^6 , R^7 , R^8 and R^9 taken together form an aromatic ring.

25 10. The process as recited in claim 6, wherein (V) has the formula

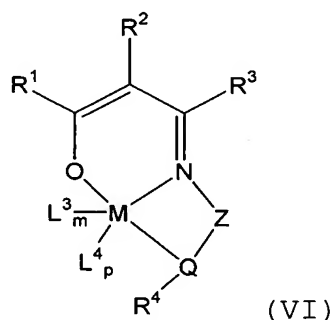


30 wherein R^{24} , R^{25} , R^{26} , R^{27} , R^{29} , R^{30} , R^{31} and R^{32} are each independently hydrogen, hydrocarbyl, substituted

hydrocarbyl or a functional group, and R^{28} is hydrogen, hydrocarbyl, or substituted hydrocarbyl, provided that any two of R^{24} , R^{25} , R^{26} , R^{27} , R^{29} , R^{30} , R^{31} and R^{32} vicinal to one another may be taken together to form a ring, and that R^{27} and R^{28} may be taken together to form a ring, or R^{28} and R^{29} may be taken together to form a ring.

11. The process as recited in claim 6, wherein the monomers and compound of the formula (V) are contacted in the further presence of a catalyst activator.

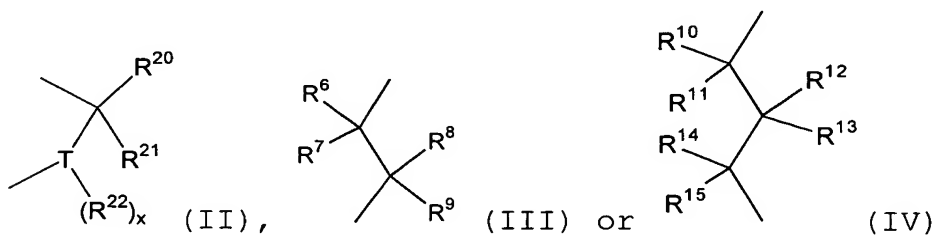
12. A compound of the formula (VI)



wherein:

R^1 is hydrocarbyl or substituted hydrocarbyl, R^2 is hydrogen, hydrocarbyl or substituted hydrocarbyl, and R^3 is hydrogen, hydrocarbyl, substituted hydrocarbyl or a functional group, provided that R^1 and R^2 taken together may be ortho-arylene or substituted ortho-arylene, or R^1 , R^2 and R^3 taken together may form one or more rings;

Z is a bridging group of the formula (II), (III) or (IV)



Q is nitrogen, oxygen, phosphorous or sulfur,
provided that when Z is (II), Q is oxygen;

R⁴ is hydrogen, hydrocarbyl or substituted
hydrocarbyl, provided that when Q is oxygen or sulfur
5 R⁴ is not present;

R⁶ is hydrogen, hydrocarbyl or substituted
hydrocarbyl, provided that R³ and R⁶ taken together may
form a ring;

R⁷ is hydrogen, hydrocarbyl or substituted
10 hydrocarbyl, provided that R³, R⁶ and R⁷ taken together
may form an aromatic ring, or R⁶ and R⁷ taken together
may form a ring;

R⁸ is hydrogen, hydrocarbyl or substituted
hydrocarbyl;

15 R⁹ is hydrogen, hydrocarbyl or substituted
hydrocarbyl, provided that R⁴ and R⁹ taken together may
be part of a double bond to an imino nitrogen atom, or
R⁸ and R⁹ taken together may form a carbonyl with the
carbon to which they are attached, or R⁸ and R⁹ taken
20 together may form a ring, or R⁴ and R⁹ taken together
may form a ring, or R⁴, R⁸ and R⁹ taken together may
form a ring, or R⁶, R⁷, R⁸ and R⁹ taken together may
form an aromatic ring;

R¹⁰, R¹¹, R¹² and R¹³ are each independently
25 hydrogen, hydrocarbyl or substituted hydrocarbyl,
provided that R¹⁰, R¹¹, R¹² and R¹³ taken together may
be ortho-arylene;

R¹⁴ and R¹⁵ are each independently hydrogen,
hydrocarbyl or substituted hydrocarbyl, provided that
30 R¹⁴ and R¹⁵ taken together may form a carbonyl with the
carbon to which they are attached, or R¹², R¹³, R¹⁴, and
R¹⁵ taken together may form an o-arylene group, or R¹⁰,
R¹¹, R¹², R¹³, R¹⁴, and R¹⁵ taken together may form a
fused aromatic ring system, or R¹³ and R¹⁴ taken
35 together may form a ring;

R²⁰ and R²¹ are each independently hydrogen,
hydrocarbyl or substituted hydrocarbyl, or R²⁰ and R²¹
taken together may form a ring;

each R²² is individually hydrocarbyl, oxygen or alkoxy, provided that when R²² is oxygen, two of R²² are taken together to form T=O;

n is an integer of 1 or more;

5 T is phosphorous or sulfur whose oxidation state is 3 or greater;

x is equal to the oxidation state of T minus 2;

M is Ti, Zr, Hf, V, Mn or Cr;

10 m is an integer equal to the valence of M minus 2; and

p is 0 or 1; and

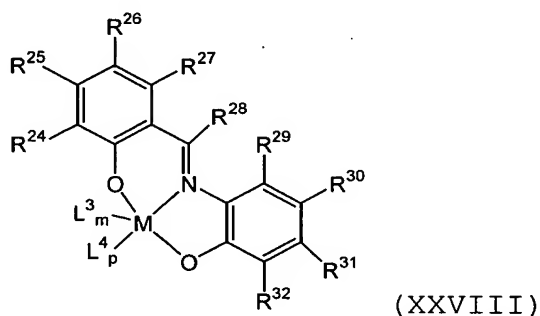
each L³ is independently a monodentate monoanionic ligand, and L⁴ is a monodentate neutral ligand or an empty coordination site, provided that an L³ and L⁴ taken together may be a monoanionic bidentate ligand.

13. The compound as recited in claim 12, wherein M is selected from the group consisting of Zr and Ti.

20 14. The compound as recited in claim 12, wherein R¹ and R² taken together are o-arylene, Z is a group of the formula (III), Q is oxygen, and R⁶, R⁷, R⁸ and R⁹ taken together form an aromatic ring.

15. The compound as recited in claim 12, wherein (VI) has the formula

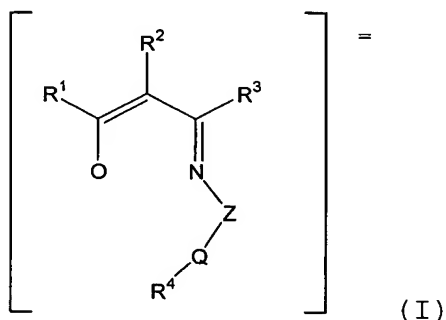
25



wherein R²⁴, R²⁵, R²⁶, R²⁷, R²⁹, R³⁰, R³¹ and R³² are each independently hydrogen, hydrocarbyl, substituted hydrocarbyl or a functional group, and R²⁸ is hydrogen, hydrocarbyl, or substituted hydrocarbyl, provided that any two of R²⁴, R²⁵, R²⁶, R²⁷, R²⁹, R³⁰, R³¹ and R³²

vicinal to one another may be taken together to form a ring, and that R²⁷ and R²⁸ may be taken together to form a ring, or R²⁸ and R²⁹ may be taken together to form a ring.

- 5 16. A polymerization catalyst component comprising a Ti, Zr, Hf, V, Mn or Cr complex of an anion of the formula (I)

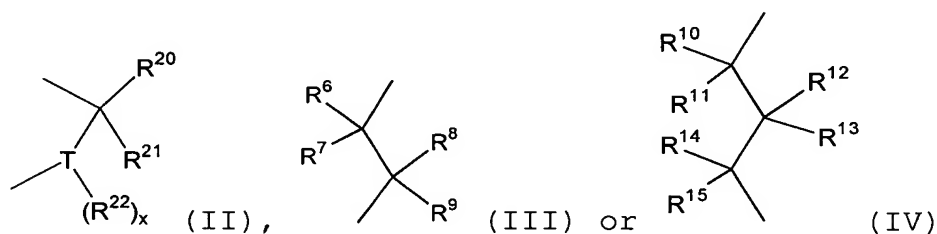


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wherein:

- R¹ is hydrocarbyl or substituted hydrocarbyl,
 R² is hydrogen, hydrocarbyl or substituted hydrocarbyl,
 and R³ is hydrogen, hydrocarbyl, substituted
 15 hydrocarbyl or a functional group, provided that R¹ and
 R² taken together may be ortho-arylene or substituted
 ortho-arylene, or R¹, R² and R³ taken together may form
 one or more rings;

- Z is a bridging group of the formula (II),
 20 (III) or (IV)



- Q is nitrogen, oxygen, phosphorous or sulfur,
 25 provided that when Z is (II), Q is oxygen;

R⁴ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that when Q is oxygen or sulfur R⁴ is not present;

R⁶ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R³ and R⁶ together may form a ring;

5 R⁷ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R³, R⁶ and R⁷ together may form an aromatic ring, or R⁶ and R⁷ taken together may form a ring;

R⁸ is hydrogen, hydrocarbyl or substituted hydrocarbyl;

10 R⁹ is hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R⁴ and R⁹ taken together may be part of a double bond to an imino nitrogen atom, or R⁸ and R⁹ taken together may form a carbonyl with the carbon to which they are attached, or R⁸ and R⁹ taken
15 together may form a ring, or R⁴ and R⁹ taken together may form a ring, or R⁴, R⁸ and R⁹ taken together may form a ring, or R⁶, R⁷, R⁸ and R⁹ taken together may form an aromatic ring;

20 R¹⁰, R¹¹, R¹² and R¹³ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that R¹⁰, R¹¹, R¹² and R¹³ taken together may be ortho-arylene;

R¹⁴ and R¹⁵ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, provided that
25 R¹⁴ and R¹⁵ taken together may form a carbonyl with the carbon to which they are attached, or R¹², R¹³, R¹⁴, and R¹⁵ taken together may form an o-arylene group, or R¹⁰, R¹¹, R¹², R¹³, R¹⁴, and R¹⁵ taken together may form a fused aromatic ring system, or R¹³ and R¹⁴ taken
30 together may form a ring;

R²⁰ and R²¹ are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl, or R²⁰ and R²¹ taken together may form a ring;

35 each R²² is individually hydrocarbyl, oxygen or alkoxy, provided that when R²² is oxygen, two of R²² are taken together to form T=O;

n is an integer of 1 or more;

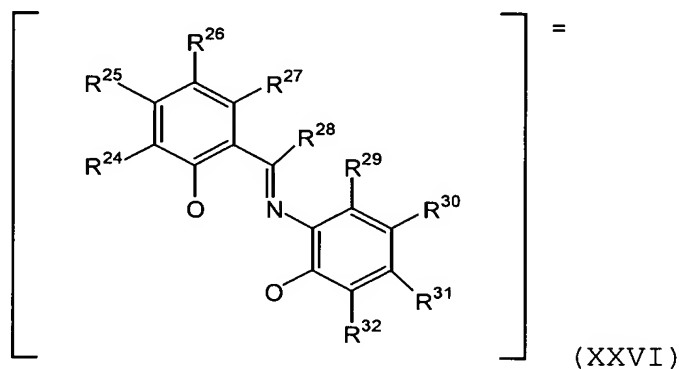
T is phosphorous or sulfur whose oxidation state is 3 or greater; and

x is equal to the oxidation state of T minus 2.

17. The polymerization catalyst component as recited in claim 16, wherein the transition metal is selected from the group consisting of Zr and Ti.

18. The polymerization catalyst component as recited in claim 16, wherein R¹ and R² taken together are o-arylene, Z is a group of the formula (III), Q is oxygen, and R⁶, R⁷, R⁸ and R⁹ taken together form an aromatic ring.

19. The polymerization catalyst component as recited in claim 18, wherein (I) has the formula



wherein R²⁴, R²⁵, R²⁶, R²⁷, R²⁹, R³⁰, R³¹ and R³² are each independently hydrogen, hydrocarbyl, substituted hydrocarbyl or a functional group, and R²⁸ is hydrogen, hydrocarbyl, or substituted hydrocarbyl, provided that any two of R²⁴, R²⁵, R²⁶, R²⁷, R²⁹, R³⁰, R³¹ and R³² vicinal to one another may be taken together to form a ring, and that R²⁷ and R²⁸ may be taken together to form a ring, or R²⁸ and R²⁹ may be taken together to form a ring.

20. The polymerization catalyst component as recited in claim 16, further comprising a catalyst activator.